DOCUMENT RESUME

ED 108 899 SE 019 087

AUTHOR Bogut, Thomas L.
TITLE The Effects of Sequencing Selected Instructional Strategies on the Attitudes and Open-Mindedness of Pre-Service Elementary Science Teachers.
PUB DATE Mar 75
NOTE 18p.; Paper presented at the annual meeting of the National Association for Research in Science Teaching (48th, Los Angeles, California, March 1975)

EDRS PRICE MF-$0.76 HC-$1.58 PLUS POSTAGE
DESCRIPTORS *Attitudes; Changing Attitudes; Educational Research; *Elementary School Science; Higher Education; *Preservice Education; Science Education; *Science Teachers; *Teacher Attitudes; Teacher Characteristics
IDENTIFIERS Research Reports

ABSTRACT

Described is a study undertaken to explore attitudinal changes of preservice elementary science teachers that result from exposure to structured and unstructured instructional strategies and factors having a possible correlation with these changes. Twenty preservice elementary education students enrolled in a nontraditional elementary teacher education program participated in the study. Two treatment groups were randomly selected and assigned to a structured instructional treatment group or an unstructured treatment group. A Semantic Differential Attitude Inventory was used to measure change and the Rokeach Dogmatism Scale (Form E) was used to determine the degree of open- or closed-mindedness. Subjects were both pre- and posttested (after four weeks) using the same instruments. Instructional treatments were reversed and the same procedure was followed. Data were analyzed using a multivariate analysis of covariance. A final conclusion made was that the degree of initial open-mindedness appeared to be the single most important factor in producing attitudinal changes. Structured teaching strategies led to more closed-mindedness than nonstructured. (EB)

****
* Documents acquired by ERIC include many informal unpublished *
* materials not available from other sources. ERIC makes every effort *
* to obtain the best copy available. nevertheless, items of marginal *
* reproducibility are often encountered and this affects the quality *
* of the microfiche and hardcopy reproductions ERIC makes available *
* via the ERIC Document Reproduction Service (EDRS). EDRS is not *
* responsible for the quality of the original document. Reproductions *
* supplied by EDRS are the best that can be made from the original. *
****

U.S. DEPARTMENT OF HEALTH,
EDUCATION & WELFARE
NATIONAL INSTITUTE OF
EDUCATION
THIS DOCUMENT HAS BEEN REPRO
DUCED EXACTLY AS RECEIVED FROM
THE PERSON OR ORGANIZATION ORIGIN
ATING IT. POINTS OF VIEW OR OPINIONS
STATED DO NOT NECESSARILY REPRE
SENT OFFICIAL NATIONAL INSTITUTE OF
EDUCATION POSITION OR POLICY

ED108899

THE EFFECTS OF SEQUENCING SELECTED INSTRUCTIONAL STRATEGIES ON THE ATTITUDES AND OPEN-MINDEDNESS OF PRE-SERVICE ELEMENTARY SCIENCE TEACHERS

by
Thomas L. Bogut
College of Education
The Ohio State University
Mansfield, Ohio

A paper presented at the Forty-Eighth Annual Meeting
of the NATIONAL ASSOCIATION FOR RESEARCH IN SCIENCE TEACHING
Los Angeles, Cal. March, 1975.

SE 019 087

Introduction to the study.

The attitudes of elementary teachers toward science is a most important factor in the total learning process. Research reported by Toth (1), James (2), Taylor (3), indicates that teacher attitudes can influence both the attitudes and achievement of elementary children in science. Hone and Carswell (4) feel that developing positive attitudinal changes should be the primary goal of in-service science education. They state...

> Childrens' built-in radar is fine-tuned to their teacher's feelings about science. Paraphrasing Emerson, children sense intuitively; "How you feel about science speaks so loud we can't hear what you say'....

They further suggest that the feelings of inadequacy and distaste toward science that are so often expressed by so many teachers, can be changed through appropriate and careful attention to in-service programs.

Since the attitudes of a teacher toward the teaching of science seems to affect both student learning and attitudes, it becomes important for us to explore strategies that might help produce more positive teacher attitudinal changes.

Objectives of the study.

The objectives of this study were to (1) explore the attitudinal changes of pre-service elementary science teachers that result from exposure to structured and unstructured instructional strategies, and to determine if (a) the sequencing of these instructional strategies or (b) the initial degree of open- or closed-mindedness of the pre-service teachers has any relationship to these attitudinal changes. An additional

objective was to determine whether the degree of open-mindedness existing in students can be increased through the use of either of the two instructional strategies.

Population.

The population used in this study consisted of 21 pre-service elementary education students enrolled at a large Midwestern University. Nearly all of the students were first semester seniors with a few being second semester juniors. All 21 students originally participated in the study, but the scores of one student were eliminated in order to equalize the number.

Criterion Instruments and Reliability.

Two basic instruments, the Semantic Differential Attitude Inventory and the Rokeach Dogmatism Scale (Form E), were used in this study to evaluate the attitudes and degree of open-mindedness of the students.

Semantic Differential.

This instrument can be described as a five point interval, unidimensional, semantic differential that uses seven polarized adjectives. Seven concepts of elementary pre-service teachers were investigated. They were:

A. Myself as an elementary science teacher
B. Pupil directed and initiated learning experiences
C. Science
D. Open Education
E. Discrepant events or torpedoing
F. Time used in "messing around" or "exploration"
G. Myself not knowing the "right" answers

Reliability

To determine the reliability of the Semantic Differential instrument, a principal components varimax rotation, factor analysis was conducted to determine the factor loadings of the various responses. The factor loadings were used to assign the items to their respective sub-scale, and then the Cronbach Alpha was calculated to determine the internal consistency of the instrument. Only the scales that maintained their cluster throughout the rotation were used in the final instrument. Table 1 presents the item reliability scores, and total test reliability.

Table 1

Semantic Differential
Item and Total Test Reliability

Item	R (Scale)
Friendly-Aloof	.7441
Strong-Weak	.7740
Valuable-Worthless	.6322
Nice-Mean	.6704
Unpleasant-Pleasant	.7868
Interesting-Boring	.7442
Good-Bad	.7526
Total Test R	.8523

Rokeach Dogmatism Scale. (Form E)

This instrument can be described as a forced choice, Likert-type scaling device and was developed by Milton Rokeach. (1960) A score on this instrument is an indication of an individual's open- or closed-mindedness. The higher the score, the more closed-minded an individual is. This instrument was administered to the students under the title, 'Opinionnaire.'

Reliability.

Rokeach (5), in his research with seven groups of Midwestern college students, obtained reliability coefficients ranging from 0.68 to 0.85. Jaus (6), using 90 subjects, obtained a reliability coefficient of 0.83 using the Spearman-Brown formula.

Procedures.

At the first class meeting, all students were administered the Rokeach Dogmatism Scale (Form E) and the Semantic Differential Attitude Inventory.

After scoring the Rokeach Dogmatism Scale, the scores of the students were ranked in order ranging from the lowest to the highest. The middle score was eliminated thus reducing the N to 20, and allowing the formation of two equal sized groups of 10 each. Using a table of random numbers, the students with the lowest 10 scores were assigned into two instructional groups. These groups were designated as structured and unstructured treatment groups. The same procedure was followed to assign the remaining 10 students. As a result of this stratification, both the treatment groups consisted of equal numbers of randomly assigned high and low dogmatic students.

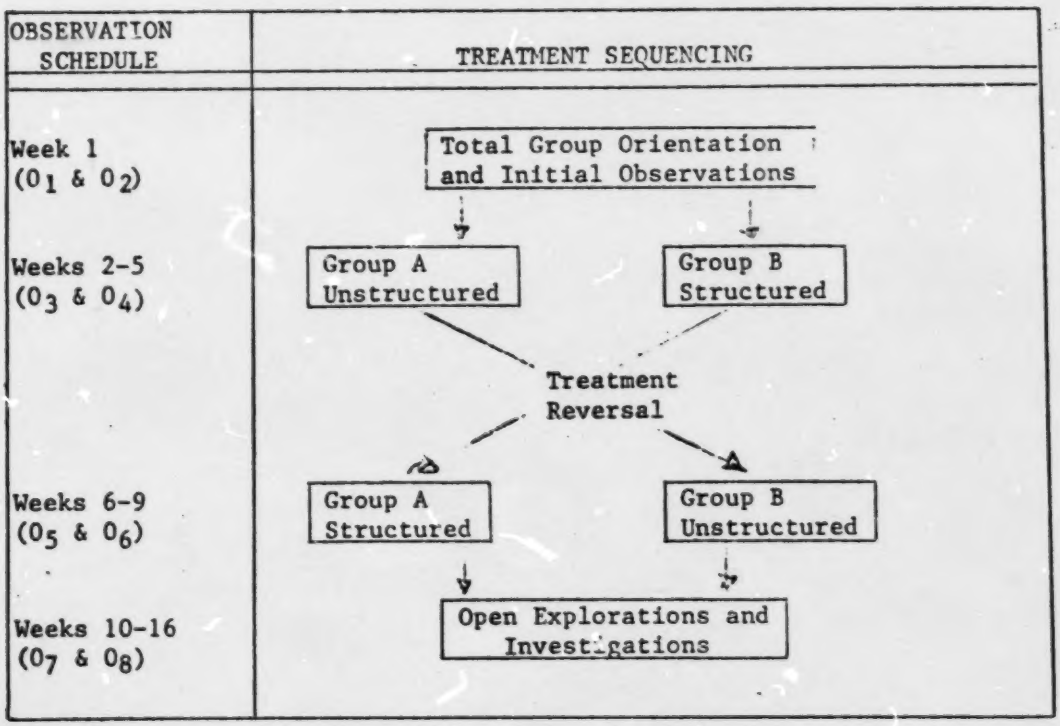
After exposing both groups to differing instructional treatments for a period of four weeks, the same criterion measures described earlier were administered to both groups. Immediately following this set of observations, the instructional treatments of the groups were reversed and the treatment cycle repeated. *

*Although the treatment of the group changed, the title of the group being treated remains the same. In other words, the group that was initially identified as the unstructured treatment group will retain that designation even though the specific treatment of the group was changed from unstructured to structured.

Figure 1 presents the treatment-reversal-observation schedule in detail.

FIGURE I

Treatment and Observation Flow Chart



O_1, O_3, O_5, O_7 = Rokeach Dogmatism Scale

O_2, O_4, O_6, O_8 = Semantic Differential

At the end of the eighth instructional week when the instructional treatments between the two groups had been equalized, the criterion instruments were again administered. At this point in time, both groups had received exactly the same treatments but in different sequence. Figure II illustrates the various controlled educational experiences that the students underwent along with sequencing of those experiences.

FIGURE II

Treatment Schedule, Description, and Sequencing

Week	Unstructured Group (High Involvement)	Structured Group (Low Involvement)
I (O_1, O_2)	Orientation and Initial Observations	Orientation and Initial Observations
II	Clay Boats (ESS)	Performance Objectives
III	Mystery Powders (ESS)	Basic Process Skills
IV	Batteries and Bulbs	
V (O_3, O_4)	Whirly Birds (SCIS)	Integrated Process Skills
VI	Treatments Reversed for Both Groups	
VII		
VIII		
IX (O_5, O_6)		
X-XVI (O_7, O_8)		

The final eight weeks of the semester were used by the students to independently explore and investigate various science topics and activities of their own choosing. Suggestions for possible investigations and explorations were presented by the instructor in the form of a mimeographed exploration guide (7). The activities in this exploration guide ranged from the collecting of materials and the construction of equipment to the teaching of various selected science concepts to groups of elementary school pupils.

Treatment Description.

Unstructured Group (High Involvement)

The instructional strategy employed in exposing the unstructured group to the various elementary science instructional units followed the same basic pattern regardless of the particular subject matter being explored. This pattern was as follows: (1) Introduction, (2) Exploratory Period, (3) Evaluation.

(1) Introduction. A brief explanation of the particular program or unit about to be explored was given by the instructor to the group. Also at this time, the specific tasks that were to be accomplished and the materials to be used by the students during this exploratory period were also explained and discussed.

(2) Exploratory Period. During this period, the students were involved in "hands on" material exploration, problem solving, and in general, investigating the various phases of the different programs.

Also during this exploration period, the instructor was involved with each of the students asking and answering questions, making suggestions, and giving encouragement.

(3) Evaluation. The evaluation of the learning experience was done by both the instructor and the class as a total group. The students were encouraged to share their experiences, their feelings, and their opinions of the instructional unit.

Structured Group (Low Involvement)

The treatment procedures for the structured group followed a different pattern. During the performance objectives phase of the treatment, the instructor operated the tape recorder and slide projector

and was available to answer questions and make general comments.

During both the basic and integrated process skills phases of the treatment, the instructor organized the quipment, distributed the instructional materials and was available to answer questions and give any help needed. Basically, the students performed the tasks independently with little help or guidance needed on the part of the instructor. It should be pointed out, however, that the instructor was continually circulating among the students, offering help, asking questions and making positive comments during these work periods.

Open Period

During the last eight weeks of the semester, all students worked on individually selected tasks regardless of what their initial treatment group was. During this time, the investigator worked with and helped the students on an individual basis.

** Results

Table II presents the raw data obtained from the Semantic Differential instrument, for all observations, all groups, all concepts.

TABLE II

Semantic Differential Means for Structured and Unstructured Groups. All Concepts and Observations. (N=20)

	OBS I		OBS II		OBS III		OBS IV	
Concept.	Struct.	Unstr.	Struct.	Unstr.	Struct.	Unstr.	Struct.	Unstr.
S.D. #1	29.6	28.3	28.0	28.6	28.5	29.8	30.5	32.9
S.D. #2	28.7	31.6	30.5	30.8	29.2	31.7	31.0	33.3
S.D. #3	29.5	29.9	29.2	30.0	30.3	31.8	31.8	33.5
S.D. #4	29.9	31.4	28.6	31.4	30.7	31.9	31.2	32.7
S.D. #5	23.3	20.4	25.3	19.3	27.6	22.0	31.2	29.3
S.D. #6	31.4	32.3	30.3	31.4	33.0	31.3	31.5	32.0
S.D. #7	25.0	24.1	23.6	22.4	25.5	22.2	26.6	23.0

To determine if there were any significant total attitudinal gains resulting from the different treatments, an analysis of covariance was conducted. Table III presents this data.

** In many of the tables displayed in this paper, the specific group descriptions AO, BO, AC, BC, will be used. The letter A or B designates the particular group, while the letter O or C refer to the degree of open-mindedness of the particular group. In other words, the abbreviation of AO would refer to the unstructured, open-minded group, while the term BC would refer to the structured, closed-minded group.

TABLE III

Analysis of Covariance-Observations I versus IV
All Groups - All Concepts

Source	d.f.	F-Score
S.D. #1	15	4.6534 *
S.D. #2	15	8.0174 *
S.D. #3	15	2.5821
S.D. #4	15	18.0726 *
S.D. #5	15	.9427
S.D. #6	15	.0193
S.D. #7	15	.6791

* .05 = 4.454

To determine if any of these significant results could be attributed to any particular group, t tests were conducted. Only the first concept (Myself as an Elementary Science Teacher) produced significant results. Table IV presents the results of these calculations.

TABLE IV

t Comparisons for Observations I versus IV, All Groups, Concept #1
(Myself as an Elementary Science Teacher)

Group	d.f.	t	Probability
AC	8	2.817	.0283
AC	8	1.106	.3009
BC	8	.705	.5009
BC	8	.220	.8314

An examination of Table IV reveals that sub-group AO (Unstructured-Open) produced a t score of 2.817 which is significant at the .0283 level of confidence. It also appears that sub-group AC (Unstructured-Closed) also tended to produce more changes than either of the remaining groups, but not to a significant level.

The data obtained from the Rokeach Dogmatism Scale is presented in Table V.

TABLE V

Rokeach Dogmatism Scale MEANS
All Groups, All Observations

Group	OBS.I MEAN	OBS.II MEAN	OBS.III MEAN	OBS.IV MEAN
AO	121.8	140.8	128.0	127.4
AC	183.8	189.6	181.8	177.0
BO	117.0	129.2	137.4	141.8
BC	173.6	161.6	145.2	168.2

An analysis of covariance was conducted in order to determine if any significance could be attributed to the changes in scores. Table VI reflects this analysis.

TABLE VI

Analysis of Covariance for Rokeach Dogmatism Scale, Observations I versus III and I versus IV

Observation	d.f.	F-Score
1 vs 3	15	8.0553 *
1 vs 4	15	4.6534 *

* .05 = 4.454

Inasmuch as both F-scores were significant, t tests were conducted to determine if any of the significance could be attributed to any specific group. Table VII presents the results of these calculations.

TABLE VII

t Comparisons for Observations 1 versus 3, and 1 versus 4. Rokeach Dogmatism Scale. All Groups

Group	d.f.	OBS. 1 vs. 3		OBS. 1 vs. 4	
		t	Prob.	t	Prob.
AO	8	.351	.7344	.303	.7700
AC	8	.161	.8761	.415	.6892
BO	8	1.70	.1536	2.348	.0468 *
BC	8	1.33	.2180	.473	.6491

It can be observed that only the Structured-Open group in comparison 1 vs 4, produced a t score that was significant. It is interesting to note however, that this group moved toward being more closed-minded, rather than in the anticipated directions of becoming more open-minded.

Conclusions.

1. The sequencing of instructional strategies does not appear to make any significant differences in terms of student attitudinal changes. However, there does appear to be some indication that the attitudes of students involved in the unstructured - structured treatment sequence were somewhat more positive than the attitudes of students involved in the structured - unstructured sequence, although these differences were not significant. In effect, it appears that the order in which instructional strategies are sequenced has little effect on the attitudinal changes of students as long as both treatment groups eventually receive the same treatment.

2. Open-minded students, after being subjected to unstructured teaching strategies, remain open-minded.

3. Closed-minded students, when exposed to unstructured teaching strategies, become more open-minded.

4. Open-minded students, when exposed to structured instructional strategies, become more closed-minded.

5. Closed-minded students, when subjected to structured teaching strategies, become more open-minded.

It is apparent that there were at least two different processes in operation. On one hand, open-minded students who were allowed to operate in an environment where they can set their own instructional goals, determine their own rate of learning within a learning style that is consistent with their feelings, remain open-minded. It is apparent that these students feel quite comfortable in an unstructured, flexible, self-directed, instructional mode. In effect, these open-minded students remain open-minded, which in itself is a desirable condition. On the other hand

we have open-minded students who were required to operate in a specified results. The open-minded students assigned to the structured treatment group, were required to operate within an instructional mode that they viewed as undesirable. Perhaps, it is not surprising that a certain amount of resentment should arise and possibly be reflected in negative responses in both their attitudes and degree of open-mindedness.

Another interesting phenomenon that appears to have taken place is the fact that the closed-minded students from both the structured and unstructured treatment groups moved toward becoming more open-minded, regardless of the amount of structure inherent in the treatment. These results are most puzzling and raise many more questions than they answer. For example:

a. Is it possible that the closed-minded students expect to follow the instructor's directions, regardless of the structure involved, and consequently feel comfortable in doing so?

b. Is it possible that the closed-minded students, exposed to the unstructured teaching strategies of Treatment Group A, become more open-minded as a result of the treatment?

c. Is it possible that the closed-minded student originally felt very apprehensive about this science methods class, but mellowed somewhat when they found out that the experience was not too unpleasant?

6. The final conclusion that appears warranted is that the degree of open-mindedness appears to be the single-most important factor in producing attitudinal changes. The open-minded group made more significant gains on the various sub-concepts investigated than did the closed-minded group. This was quite consistently true throughout the

observations, especially regarding the students confidence in themselves as effective elementary science teachers.

It appears that the open-minded students are quite predictable in that they will react quite favorably toward innovative or non-traditional teaching strategies. It also appears that while the open-minded groups made significant attitudinal gains between the beginning and the end of the experiment, the greatest change was made by the unstructured - open treatment group. Consequently, in terms of the total open-minded group, the greatest gains were achieved by the unstructured sub-group (AO) followed by the structured sub-group (BO).

The possibility exists that science educators should give consideration to using different instructional approaches with different types of students. In other words, perhaps some approaches to the matching of instructional strategies to the learning style of the students should be implemented. Science educators should be just as concerned about maintaining the positive attitudes of open-minded students as they are about attempting to develop positive attitudes in others. It is entirely possible that many elementary methods students come to their science methods class with very positive attitudes, and end the semester with less positive attitudes as the result of the instructional strategies employed by the instructor.

REFERENCES

1. Toth, George P. "Assessing Science Attitudes as an Entering Behavior of Pre-Service Elementary Science Teachers." Paper presented to the 22nd Annual Convention of the National Science Teachers Association. Chicago, Ill.

2. James, Helen H. Attitude and Attitude Change: Its Influence upon Teaching Behavior. Journal of Research in Science Teaching. Vol. 8, No. 4. 1971.

3. Taylor, Alton L. The Influence of Teacher Attitudes and Individual Difference on Pupil Achievement With Programmed Science Materials. Research Reports. Journal of Research in Science Teaching. Nov. 4, 1966. 38-39.

4. Hone, Elizabeth and Carswell, Evelyn M. "Elements of Successful Inservice Education." Science and Children. Vol. 6, No. 5 Jan. Feb. 1909. (24-26)

5. Rokeach, Milton. The Open and Closed Mind. Basic Books, Inc. New York, New York 1960.

6. Jaus, Harold Henry. The Effects of Integrated Science Process Skill Instruction on the Achievement and Planning Practices of Prospective Elementary Teachers. (Doctoral Dissertation, Indiana University) 1973.

7. Bogut, Thomas L. Independent Science Explorations for Elementary Teachers. Indiana University. 1974.